

Research and Practice Innovations

Substituting Brown Rice for White Rice to Lower Diabetes Risk: A Focus-Group Study in Chinese Adults

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ABSTRACT

Whole-grain products, such as brown rice, have been associated with lower risk of diabetes. However, information is lacking on the acceptability of substituting brown rice for white rice. This study assessed the awareness and acceptability of brown rice in Chinese adults, and examined the feasibility of introducing brown rice into the diet through a large, long-term randomized clinical trial to lower risk of type 2 diabetes. Thirty-two Chinese adults residing in Shanghai participated in this quantitative and qualitative study using questionnaires and focus-group discussions. Most participants (30 of 32) consumed white rice daily and only a few (n=8) had tried brown rice previously. Before tasting, most participants considered brown rice inferior to white rice in terms of taste and quality. However, after tasting brown rice and learning about its nutritional value, the majority indicated greater

willingness to consume brown rice. Main barriers to acceptance were the perception of rough texture and unpalatable taste, as well as higher price. All participants suggested that large-scale promotion was needed to change societal attitudes toward brown rice. In addition, most participants (27 of 32) expressed willingness to participate in a future long-term brown rice intervention study. These results provide valuable information for the design of the future brown rice intervention trial and highlight the importance of increasing awareness about the nutritional value of brown rice.

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Excess energy intake and sedentary lifestyles have led to an epidemic of type 2 diabetes in both Western (1) and Asian countries (2). The number of diabetic patients in China is projected to increase from 20.8 million in 2000 to 42.3 million in 2030 (3). Therefore, it is imperative to identify effective and simple lifestyle interventions to prevent development of diabetes.

Epidemiologic studies show that high intake of whole grains, such as brown rice, is associated with lower risks of the metabolic syndrome, diabetes, and cardiovascular disease (4-9). Because only the outermost layer (the hull) of the rice kernel is removed during processing, brown rice retains most of its nutritional value (eg, dietary fiber, essential fatty acids, and various vitamins and trace elements) (10). On the other hand, highly polished white rice contains a much smaller amount of these nutrients and compounds.

Several large epidemiologic studies conducted among US and Asian populations have reported a positive association between habitual consumption of refined carbohydrates, such as polished white rice and increased risk for diabetes (11,12). In the Shanghai Women's Health Study, a comparison of the highest and lowest categories of glycemic load (a measure of the total glycemic effect of carbohydrates in the diet) and white rice intake (the top contributor to dietary glycemic load in that cohort) found relative risks of 1.34 (95% confidence interval: 1.13 to 1.58) and 1.78 (95% confidence interval: 1.48 to 2.15), respectively (12). This study did not examine brown rice, which is rarely consumed in China.

Several small pilot studies have documented that brown rice consumption reduces postprandial blood glucose levels (13) and improves lipid profiles (14). To our knowledge, the effect of brown rice on metabolic risk factors for diabetes has not been tested in a randomized

clinical trial. White rice is a staple food and a major source of daily energy intake (accounting for >30% of daily calories) in China (15), and thus partial replacement of white rice with brown rice may have favorable effects on diabetes prevention in this population. However, little is known about awareness of brown rice in Chinese adults or whether substitution of brown rice for white rice is culturally acceptable. Obtaining such information is an important first step in conducting a randomized controlled clinical trial to evaluate the effect of substituting brown rice for white rice on markers of diabetes risk in middle-aged Chinese adults with the metabolic syndrome. Toward these ends, a mixed methods, quantitative and qualitative study using questionnaires and focus-group discussions was conducted to assess awareness of brown rice in the general population, to explore perceptions of its acceptability, and determine the feasibility of introducing brown rice into the diet through a large, long-term randomized clinical trial to lower risk of type 2 diabetes.

METHODS

Participants

Participation in this focus-group study was based on a convenience sample. Thirty-four participants (14 men and 20 women) employed by the Shanghai Institute for Biological Sciences or nearby companies were recruited through advertisements. These participants were similar in backgrounds (mostly middle-aged, educated, and employed) to potential participants of the future intervention, which will be conducted at a local university. Thirty-two participants completed the focus-group discussions and each received a bag of brown rice (2.5 kg) upon completion of the full study protocol. This study was approved by the Institutional Review Board of the Institute for Nutritional Sciences, Chinese Academy of Sciences and all participants signed informed consents.

Study Materials and Cooking Method

Brown rice used in the focus-group discussions was purchased from a local supermarket. It was soaked in cold water the night before each focus-group discussion and cooked in an automatic rice cooker the next morning. The rice-to-water ratio was 1:2.5, and the cooking time was 45 to 60 minutes (controlled automatically by the rice cooker), depending on the amount of rice (eight to 10 servings). The cafeteria at the Shanghai Institute for Biological Sciences provided cooked white rice and other dishes (two servings of vegetables and one serving of meat/fish per person).

Procedures

Focus-group discussions took place during the lunch period. Before rice-tasting, all participants completed a questionnaire on demographics (sex, race, age, income, educational attainment, employment status, etc) and usual rice-consumption habits. The purpose of the pre-tasting questionnaire was to collect these data because such information is difficult to obtain during focus-group discussions. Questions about rice intake were based on a

1. Please describe what are the kinds of foods that people in your community generally like to eat and why?
2. Are people aware of brown rice and what do people feel about eating brown rice?
3. What do people generally prefer, white or brown rice, and why?
4. What are some of the major barriers to consuming brown rice?
5. How would people react if they were told that brown rice has better nutritional values than white rice?
6. What suggestions do you have to make brown rice more appealing to people?
7. Brown rice takes longer to cook than white rice. Would this affect the acceptability of brown rice in your community?
8. Would you be interested in participating in a study in which you will eat brown rice every lunch for 6 months? How about 3 months? How about 1 year?

Figure. Sample questions asked during focus-group discussions. Following brown rice taste tests, participants were divided into four gender-specific groups and participated in focus-group discussions. Focus-group discussions were semi-structured open conversations based on predetermined questions to assess perceptions of brown vs white rice, the influence of various factors in determining dietary habits, opinions on healthy foods, decision-making in the family about food purchasing, feasibility of introducing brown rice as the main dietary staple, and willingness to participate in the future brown rice intervention trial. All focus-group discussions were tape recorded, transcribed verbatim, and translated into English. English transcripts were coded for emerging themes.

validated food frequency questionnaire used in the Shanghai Women's Health Study (16). Participants were then served dishes of white and brown rice with accompanying vegetables/meat for lunch (consumption was ad libitum), and instructed to taste both rice types. Water was provided as the only beverage. The average intake of brown rice per person was approximately 100 g. Focus-group discussions took place after tasting and followed a protocol based on a focus-group guide (17). Because the main purpose of the focus-group discussion was to identify cultural and practical barriers to brown rice consumption, the focus-group discussion questions assessed participants' perceptions of brown vs white rice, the influence of various factors in determining dietary habits, opinions on healthy foods, decision-making in the family about food purchasing, feasibility of introducing brown rice as the main dietary staple, and willingness to participate in the future brown rice intervention trial (Figure). Only a few questions, such as favorite rice variety and factors influencing food choice, overlapped between the questionnaire and focus-group discussion.

Two investigators served as co-moderators for the focus-group discussions. Moderators received training in focus-group discussion implementation from a coauthor, with expertise in conducting focus-group research. Participants were seated around a table to facilitate communication. Each session lasted approximately 60 minutes and interviews were tape-recorded. All procedures were explained beforehand. Audiotapes were transcribed verbatim and translated into English.

Table 1. Descriptive characteristics of participants (n=32) in four focus groups seeking insight into people's perceptions of substituting white rice with brown rice to lower diabetes risk

Characteristics	Men (n=12)	Women (n=20)	All (n=32)
Age (y)	← mean ± standard deviation →		
	53 ± 7	47 ± 10	49 ± 10
	← n (%) →		
Marital status			
Unmarried	0 (0)	1 (5)	1 (3)
Married	12 (100)	18 (90)	30 (94)
Widowed	0 (0)	1 (5)	1 (3)
Education ^a			
Less than high school	3 (25)	3 (16)	6 (19)
High school	1 (8)	3 (16)	4 (13)
Bachelor's degree	8 (67)	9 (47)	17 (55)
More than bachelor's degree	0 (0)	4 (21)	4 (13)
Occupation ^a			
Manual worker	2 (17)	2 (11)	3 (10)
Office clerk	3 (25)	6 (32)	9 (29)
Manager	7 (58)	10 (53)	17 (55)
Other	0 (0)	1 (5)	1 (3)
Consume white rice everyday	11 (92)	19 (95)	30 (94)
Price paid for rice per pound (in US cents)	← mean ± standard deviation →		
	27 ± 7	27 ± 7	27 ± 7

^aOne female participant who was unwilling to participate in a future long-term brown rice intervention trial did not provide the related information.

Qualitative Data Analysis

English transcripts, four in total, were independently transcribed by two coders. Each transcript was carefully read multiple times (data immersion) and then coded inductively to allow research findings to emerge from the raw data. Transcripts were coded by inserting a word or phrase into the margin of the transcript next to segments of text that related to key issue(s), thereby flagging emerging themes. Coding was guided mainly by research questions. A code book or common coding framework was then created that listed all codes, with overlapping ones consolidated under one theme; ie, broad categories from the coded data were developed that captured key themes (18). Several themes were identified through the focus-group discussions. By having two independent coders, a form of researcher triangulation, the validity of the data is enhanced. In contrast to quantitative research, interrater reliability does not require consideration here because discordant themes between coders is just as informative as concordant ones because they raise issues that warrant further investigation.

Quantitative Data Analysis

Data about participant demographics and rice consumption habits were obtained from pretasting questionnaires.

Table 2. Perceptions on factors influencing food choice among participants in brown rice focus group discussions (n=32)

Factors influencing food choice	Men (n=12)	Women (n=20)	All (n=32)
	← n (%) →		
Cost	5 (42)	7 (35)	12 (38)
Taste	6 (50)	17 (85)	23 (72)
Health	7 (58)	17 (85)	24 (75)
Ease of preparation	1 (8)	5 (25)	6 (19)
Availability	3 (25)	5 (25)	8 (25)
Tradition	4 (33)	3 (15)	7 (22)

Means and standard deviations of descriptive characteristics of focus-group participants (n=32) and factors influencing food choices by sex were computed using SAS 9.13 (SAS Corp, Cary, NC).

RESULTS

Characteristics of Participants

Four focus-group discussions were conducted, two among men and two among women. As shown in Table 1, the mean age was 53 and 47 years for men and women, respectively. Most were married, had a bachelor's degree or higher, and more than half worked in managerial-level positions. Ten participants reported that they had been previously diagnosed with diabetes (n=3), hyperlipidemia (n=4), or hypertension (n=3).

Pretasting

Frequency of Rice Consumption and Factors Influencing Food Choice. From pretasting questionnaires, we determined the frequency of rice consumption among participants. About 94% (30 of 32 participants) consumed rice daily (Table 1). Only eight participants had previously tried brown rice. The average price of white rice was US\$0.27 per pound. Health (75%) and taste (72%) were the main factors influencing food choice, followed by cost (38%) (Table 2).

Post-Tasting

Qualitative Analysis of Focus-Group Discussions: Dietary Preferences and Purchasing Practices for Specific Varieties of Rice. Focus-group data indicated that decisions to purchase white rice were based primarily on taste and texture. Appearance, price, and tradition were also identified as important factors. Sticky white rice, which goes well with many traditional foods consumed in China, was considered the most popular kind of white rice: "I usually choose white rice because it is softer and people usually prefer soft and sticky rice."

Taste rather than nutritional value ultimately determined purchasing decisions. Brand preferences of family members also played a role, but satisfying the rice preference of multiple family members was considered too costly and impractical. Advertisements were also

identified as factors exerting some influence on rice choice.

Knowledge and Awareness of Brown Rice

Many participants had no prior awareness of brown rice, and only a few had tried it previously, either as an occasional breakfast item or sometimes mixed with white rice. Very few participants knew about its nutritional value. Compared to other whole grains, brown rice was rarely available in markets. Some participants thought its brownish color was due to a longer storage period than white rice. Consumption of polished white rice was generally considered a symbol of higher living standards.

Perceptions of Brown Rice as a Substitute for White Rice

Some participants thought it would be almost impossible to change habitual eating habits and suggested that older people and individuals with health problems may be more likely to accept brown rice for health considerations, but younger people would not be so inclined. Other issues raised included prohibitively high price, taste (rough, not sticky, bad texture), and poor quality of brown rice sold in markets. Comments included that “it (brown rice) tasted like the chow for pigs.” Participants thought that the rough texture of brown rice might be difficult for the elderly to chew and digest, and may result in “stomach discomfort.” Participants also thought that brown rice would have to be acceptable to all family members to be viable and providing more detailed information on nutritional value and potential health benefits of brown rice would be especially important.

Before tasting brown rice, the majority of participants considered it to be inferior to white rice in terms of taste and quality, and felt it unlikely that individuals would change their habitual rice staple.

Some participants felt that there was no need to promote consumption of brown rice. Reasons included availability of other whole grains, such as corn and millet, which are also rich in fiber, and the ease of encouraging people to take vitamin pills rather than making dietary changes. Some thought it would be impossible to substitute brown rice for white rice because of poor taste, rough texture, cost, and more importantly, lack of familiarity. Others said that with adequate promotion of health benefits, people would be willing to replace white rice with brown rice. Participants said that “these days, people were more health conscious, and more willing to change behaviors and adopt more healthy diets and lifestyle.” After tasting, several participants indicated that they would include brown rice in their daily diet if the same quality of brown rice used in the study was available.

Possible Barriers to Acceptability and Potential Factors that Could Promote Acceptance

Taste and cost were the two most commonly cited barriers to the acceptance of brown rice. Others included unattractive appearance, lack of awareness about nutritional value, and consuming white rice as a traditional staple food. Longer cooking time was not considered a major barrier. Some participants were surprised to learn that brown rice is more expensive than white rice because it requires less energy for processing and polishing: “It is unreasonable. As it is minimally processed, there is no reason that it has the same or similar price as that of white rice; price is thus an issue and cannot be ignored. The price should be attractive.”

Focus-group participants agreed that educating the public about brown rice and actively promoting brown rice consumption were key steps to improving acceptability. Acceptance by family members was also identified as an important factor. Some felt that scientific evidence on nutritional value might convince people to switch to brown rice. Other suggestions included improving the texture of brown rice by soaking in water, mixing with white rice, grinding into flour, or cooking in a soup or porridge.

Participation in the Future Long-Term Intervention Study

Most participants indicated willingness to take part in a brown rice intervention study. Those unwilling to participate identified time constraints and being unaccustomed to brown rice as main barriers. One woman said, “I am not sure that I can eat that meal every day, so I will not participate in it.”

Among those willing to participate, women felt that 6 months was a reasonable length of time for the study, but most men preferred 3 months. Some participants were concerned about being able to consume brown rice for such a long duration of time. In general, participants were enthusiastic about the future clinical trial. Many appreciated the intervention study organizers’ efforts to undertake such a project.

DISCUSSION

This study identified several cultural barriers to the acceptance of brown rice in Chinese adults, including the perception of unpalatable taste and low quality. Before tasting brown rice, the majority of participants considered it to be inferior to white rice in terms of taste and quality, and felt it unlikely that individuals would change their habitual rice staple. However, after tasting brown rice and learning about its nutritional value, most expressed willingness to consume brown rice and participate in a future long-term brown rice intervention study to lower risk of diabetes.

In China, white rice is a staple food and major source of calories contributing to a high dietary glycemic load (15). Several epidemiologic studies have linked higher dietary glycemic load, primarily from white rice, to an increased risk of type 2 diabetes (12,19,20). Insoluble fiber in brown rice lowers postprandial blood glucose levels (13), and rice bran oil may lower cholesterol (14). Increased intake of trace elements and B vitamins found in brown rice might

also confer protection against diabetes and other metabolic disorders (21-24). Thus, substitution of brown rice for white rice could have favorable effects on reducing risk of diabetes.

Focus-group discussions are a useful vehicle for investigators to evaluate the feasibility of conducting nutrition intervention studies (25). For example, using results from a focus-group discussion, Teri and colleagues conducted an intervention study to increase whole-grain consumption and decrease refined-grain consumption during lunch for children through health education, parental involvement, and changing the food environment at school (26,27). Results from the current study also raise several important issues for conducting a future brown rice intervention study.

First, selection of the variety of rice to be used and optimization of cooking methods warrant consideration. Quality and taste are key factors in food purchases. Traditionally, polished white rice has been associated with a higher socioeconomic status, whereas brown rice is perceived as being of low quality and having a rough texture. Thus, changing the perception and choosing a variety of rice favored by local residents and adjusting cooking methods accordingly to enhance texture (ie, length of soaking and cooking, ratio between rice and water, etc) could improve compliance in a future trial.

Second, promotion and education about brown rice should be done in conjunction with increasing the availability. Considering the widespread unfamiliarity of brown rice in the general public, all focus-group members identified the need to promote brown rice, with particular emphasis on its nutritional value, including the loss of fiber and other vitamins that occurs during processing of white rice. Furthermore, because most participants in the current study were aware of health benefits from whole grains in fairly general terms, it may also be useful to provide practical information highlighting the links between whole grains (including brown rice) and reduced risk for specific chronic diseases.

Finally, it is critical to recruit highly motivated participants into a future brown rice trial to ensure a high degree of compliance. Participants in the current study felt that brown rice was more likely to be accepted by health-conscious people; those with health conditions, such as heart disease or diabetes; and older individuals. Thus, a future trial might focus on high-risk individuals with various metabolic abnormalities (eg, those meeting the criteria for the metabolic syndrome).

Overall, the mixed-methods approach, incorporating qualitative and quantitative aspects of analysis, is an important strength of our study. In addition, tasting brown rice clearly stimulated discussion of its acceptability. One potential limitation of this study is that the sample was not representative of the target population of the future intervention. However, the purpose of this focus-group study was to identify cultural and practical barriers in brown rice intervention. Thus, the representativeness of the sample is less important. Nevertheless, the participants enrolled in the focus groups had similar backgrounds (mostly middle-aged, educated, and employed) to potential participants of the future intervention, which will be conducted at a local university. Although the sample size of this study was adequate for the

qualitative analysis, there was insufficient power to identify independent correlates of willingness to participate in a future brown rice substitution trial to lower the risk of diabetes.

In conclusion, this study provides valuable insight into the acceptability of brown rice as a substitute for white rice in Chinese adults. Awareness of the nutritional value of brown rice is low in this population. However, after tasting brown rice and learning about its potential nutritional value, most participants indicated their willingness to participate in a long-term brown rice trial. These results provide important context and rationale for a proposed intervention trial to reduce diabetes risk.

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